US010589969B2

(12) **United States Patent**
Brutoco

(10) **Patent No.: US 10,589,969 B2**
(45) **Date of Patent: Mar. 17, 2020**

(54) **SYSTEM, METHOD AND APPARATUS FOR WIDESPREAD COMMERCIALIZATION OF HYDROGEN AS A CARBON-FREE ALTERNATIVE FUEL SOURCE**

(71) Applicant: **Rinaldo Brutoco**, Ojai, CA (US)

(72) Inventor: **Rinaldo Brutoco**, Ojai, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/962,475**

(22) Filed: **Apr. 25, 2018**

(65) **Prior Publication Data**

US 2019/0330033 A1 Oct. 31, 2019

(51) **Int. Cl.**

B66F 9/08	(2006.01)
B64B 1/06	(2006.01)
B66F 11/04	(2006.01)
B66C 19/00	(2006.01)

(52) **U.S. Cl.**

CPC ***B66F 9/082*** (2013.01); ***B64B 1/06*** (2013.01); ***B66F 11/04*** (2013.01); *B66C 19/007* (2013.01); *B66C 2700/01* (2013.01); *B66F 2700/09* (2013.01)

(58) **Field of Classification Search**

CPC ... B64B 1/06; B66F 9/082; B65C 1/20; B65C 1/22; B60P 1/02; B60P 1/54; B64D 9/00

USPC 244/118.1, 118.2; 414/139.9

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,687,204 A 10/1928 Hall B64B 1/62 244/97
1,876,153 A 9/1932 Spurrier .... B64D 1/22 244/104 R
2,362,966 A 11/1944 Bertsch 244/98
2,688,761 A * 9/1954 Good, Jr. B64F 1/305 14/71.5
3,094,940 A * 6/1963 Learmont B60P 1/36 104/98
3,201,065 A 8/1965 Dunn
3,620,485 A 11/1971 Egon Gelhard B64B 1/00 244/125
3,961,681 A * 6/1976 Fisher B60P 1/02 180/305

(Continued)

FOREIGN PATENT DOCUMENTS

WO WO 2005/019025 3/2005
WO WO2010051088 5/2010

OTHER PUBLICATIONS

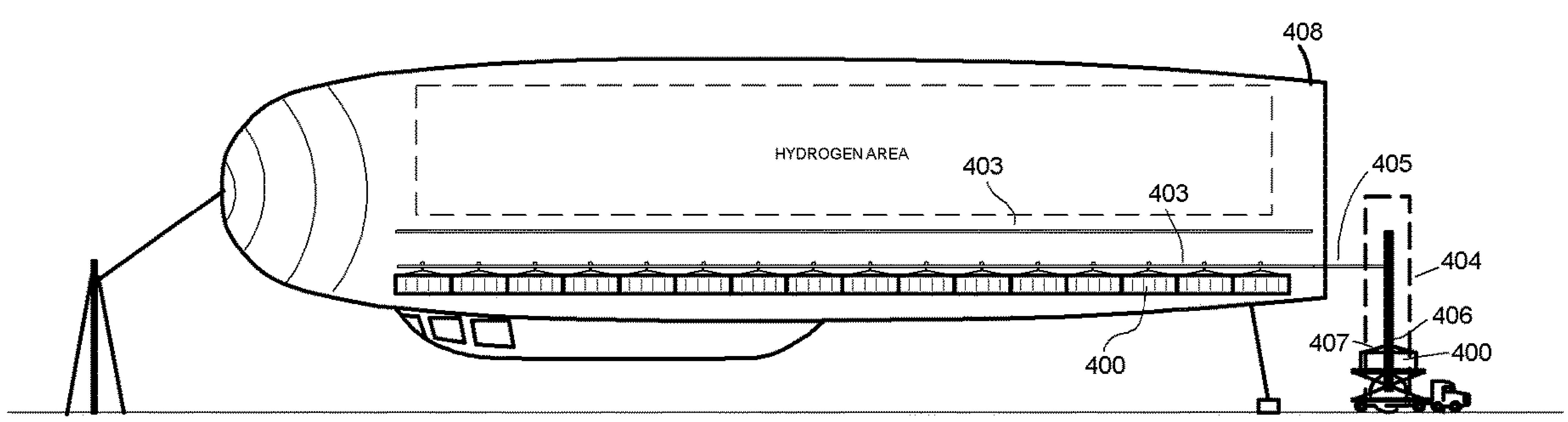
Co-pending U.S. Appl. No. 15/705,885, filed Sep. 2015.
PCT Search Report and Written Opinion PCT/US09/53339 dated Aug. 11, 2009.

Primary Examiner — Kaitlin S Joerger
(74) *Attorney, Agent, or Firm* — Clifford H. Kraft

(57) **ABSTRACT**

A loading system for a lighter-than-air craft hull that includes a vehicle that transports cargo containers into a hull loading area. This vehicle engages one of a set of longitudinal rails located inside the hull running fore and aft, where each rail has a unique vertical position and a unique horizontal position inside the hull. There is a crane to raise a particular container transported by the vehicle to the unique vertical position of one of the rails and to move it horizontally to the unique horizontal position of the rail. The crane attaches a rail wheel to the container and suspends the container from the rail. There is a rail tug that pushes or pulls the container along the rail forward into the hull to a final shipping location for that container.

17 Claims, 9 Drawing Sheets



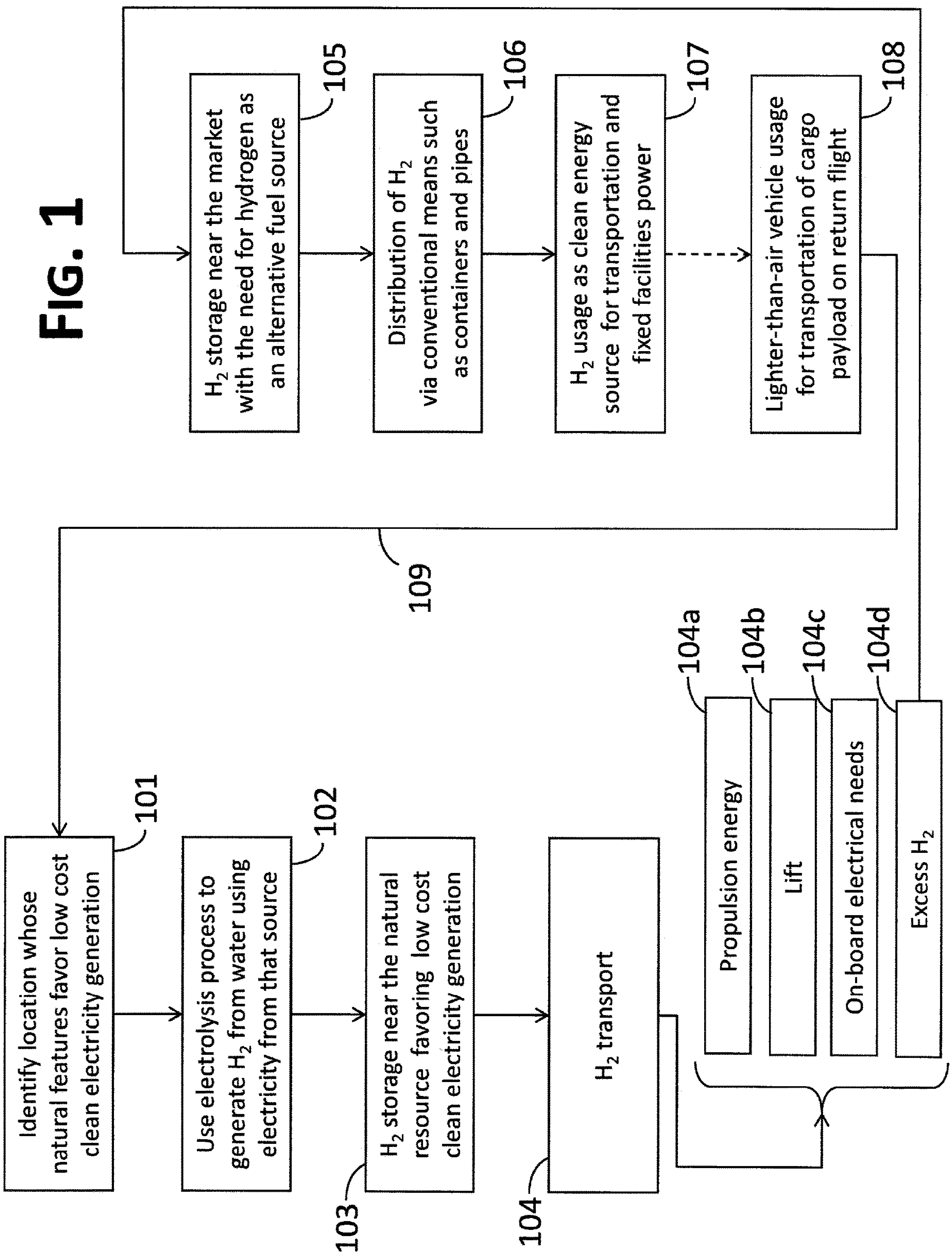
(56) **References Cited**

U.S. PATENT DOCUMENTS

3,971,533	A	7/1976	Slater	B64B 1/38	244/30
3,972,427	A *	8/1976	Stanley	B60P 1/02	244/137.1
3,972,492	A	8/1976	Milne		
4,009,850	A	3/1977	Hickey	B64F 1/14	244/115
4,032,085	A	6/1977	Papst	B64B 1/60	244/128
4,085,912	A	4/1978	Slater	B64B 1/38	244/115
4,238,095	A	12/1980	Slater	244/115	
4,272,042	A	6/1981	Slater	B64B 1/38	244/115
4,364,532	A	12/1982	Stark	B64B 1/00	126/573
4,421,286	A	12/1983	Laky et al.	244/116	
4,757,959	A	7/1988	Schroder et al.	244/2	
4,773,617	A	9/1988	McCampbell	B64B 1/60	244/128
4,934,631	A	6/1990	Birbas	B64B 1/02	244/125
5,143,322	A	9/1992	Mason	B64B 1/60	244/96
5,147,429	A	9/1992	Bartholomew	B01D 46/42	244/30
5,348,254	A	9/1994	Nakada	B64B 1/58	244/30
5,368,067	A	11/1994	Cook, Jr.	F17B 1/26	137/485
5,525,026	A *	6/1996	DeMonte	B60P 1/02	410/24
5,538,203	A	7/1996	Mellady	B64B 1/60	244/100 A
5,890,676	A	4/1999	Coleman	B64B 1/58	244/128
6,131,851	A	10/2000	Williams	B64B 1/00	244/58
6,189,829	B1	2/2001	Brotz	B64B 1/70	244/24
6,311,925	B1	11/2001	Rist	244/30	
6,328,257	B1	12/2001	Schafer	B64B 1/06	244/24
6,354,535	B1	3/2002	Perry	B64B 1/06	244/24
6,422,506	B1	7/2002	Colby	244/1 TD	
6,527,223	B1	3/2003	Mondale	B64B 1/06	244/125
6,581,873	B2	6/2003	McDermott	B64B 1/08	244/24
6,648,272	B1	11/2003	Kothmann	B64B 1/005	244/30
6,715,712	B2	4/2004	Boschma, Jr.	G09F 21/06	244/115
6,722,396	B1	4/2004	Sillat	B64B 1/58	141/10
6,769,493	B1	8/2004	Fima	A01C 7/085	169/51
6,877,693	B1 *	4/2005	Barbarie	B64B 1/00	244/121
6,883,749	B2	4/2005	Boschma, Jr.	G09F 21/06	244/115
6,896,222	B2	5/2005	Dossas	B64B 1/62	244/125
7,055,778	B2	6/2006	Eberle et al.	244/96	
7,150,430	B2	12/2006	Silansky et al.	244/30	
7,275,569	B2	10/2007	Hobbs	C01B 3/34	141/18
7,287,558	B2	10/2007	Hobbs	C01B 3/34	141/18
7,287,723	B2	10/2007	Barnes	244/31	
7,303,166	B2	12/2007	Geery	B64B 1/06	244/30
7,318,564	B1	1/2008	Marshall	244/58	
7,354,636	B2	4/2008	Lavan et al.		
7,356,390	B2	4/2008	Knoblach	B64B 1/40	244/31
7,380,750	B2	6/2008	Eberle et al.	244/96	
7,611,092	B2	11/2009	Silansky et al.	244/30	
7,690,596	B2	4/2010	Eberle et al.	244/96	
7,708,222	B2	5/2010	Lee	B64B 1/50	244/115
7,735,777	B2	6/2010	Zubrin	B64B 1/62	244/31
7,967,238	B2	6/2011	Fuchs et al.	244/2	
8,070,096	B2	12/2011	Wood et al.	244/116	
8,336,810	B2	12/2012	Brutoco		
8,702,036	B2 *	4/2014	Curry	B64D 9/00	244/118.1
8,820,681	B2	9/2014	Brutoco		
9,073,638	B2 *	7/2015	Huber	B64D 9/00	
9,102,391	B2	8/2015	Brutoco		
9,221,501	B2 *	12/2015	Lavmand	B60P 1/02	
9,493,223	B2	11/2016	Brutoco		
2002/0130220	A1	9/2002	Sparks	B64B 1/30	244/128
2003/0080245	A1	5/2003	Greenberg	B64B 1/58	244/61
2003/0141410	A1	7/2003	Senepart	B64B 1/62	244/96
2003/0147734	A1 *	8/2003	Adams	B60P 1/02	414/541
2004/0104304	A1	6/2004	Parmley	B64B 1/005	244/30
2004/0245382	A1	12/2004	Nozaki	B64D 27/24	244/53 R
2005/0236519	A1	10/2005	Handley	B64B 1/06	244/97
2006/0065777	A1	3/2006	Walden	B64B 1/60	244/97
2006/0174965	A1	8/2006	Hobbs	C01B 3/34	141/18
2006/0231678	A1	10/2006	Nagy	B64B 1/06	244/30
2007/0012819	A1	1/2007	Barnes	244/30	
2007/0069077	A1	3/2007	Colting	B64B 1/60	244/128
2007/0102571	A1	5/2007	Colting	B64B 1/06	244/30
2007/0138006	A1	6/2007	Oakes	B60L 8/00	204/278
2008/0035787	A1	2/2008	Thompson	B64B 1/24	244/97
2008/0038061	A1	2/2008	Morse		
2008/0210810	A1	9/2008	Parmley		
2008/0265086	A1	10/2008	Lee	B64B 1/50	244/30
2009/0302149	A1	12/2009	Fuchs et al.	244/2	
2010/0102164	A1	4/2010	Brutoco	244/30	
2015/0048203	A1 *	2/2015	Glass	B64B 1/38	244/118.1
2017/0081044	A1 *	3/2017	Perdue	B66C 7/06	
2017/0247101	A1 *	8/2017	Guering	B64F 5/10	
2017/0349263	A1 *	12/2017	Lopez	B64C 1/22	
2018/0016027	A1 *	1/2018	Cheatham, III	B64D 45/00	

* cited by examiner

FIG. 1


Identify location whose natural features favor low cost clean electricity generation
101
Use electrolysis process to generate H_2 from water using electricity from that source
102
H_2 storage near the natural resource favoring low cost clean electricity generation
103
H_2 transport
104
Propulsion energy
104a
Lift
104b
On-board electrical needs
104c
Excess H_2
104d
H_2 storage near the market with the need for hydrogen as an alternative fuel source
105
Distribution of H_2 via conventional means such as containers and pipes
106
H_2 usage as clean energy source for transportation and fixed facilities power
107
Lighter-than-air vehicle usage for transportation of cargo payload on return flight
108
109

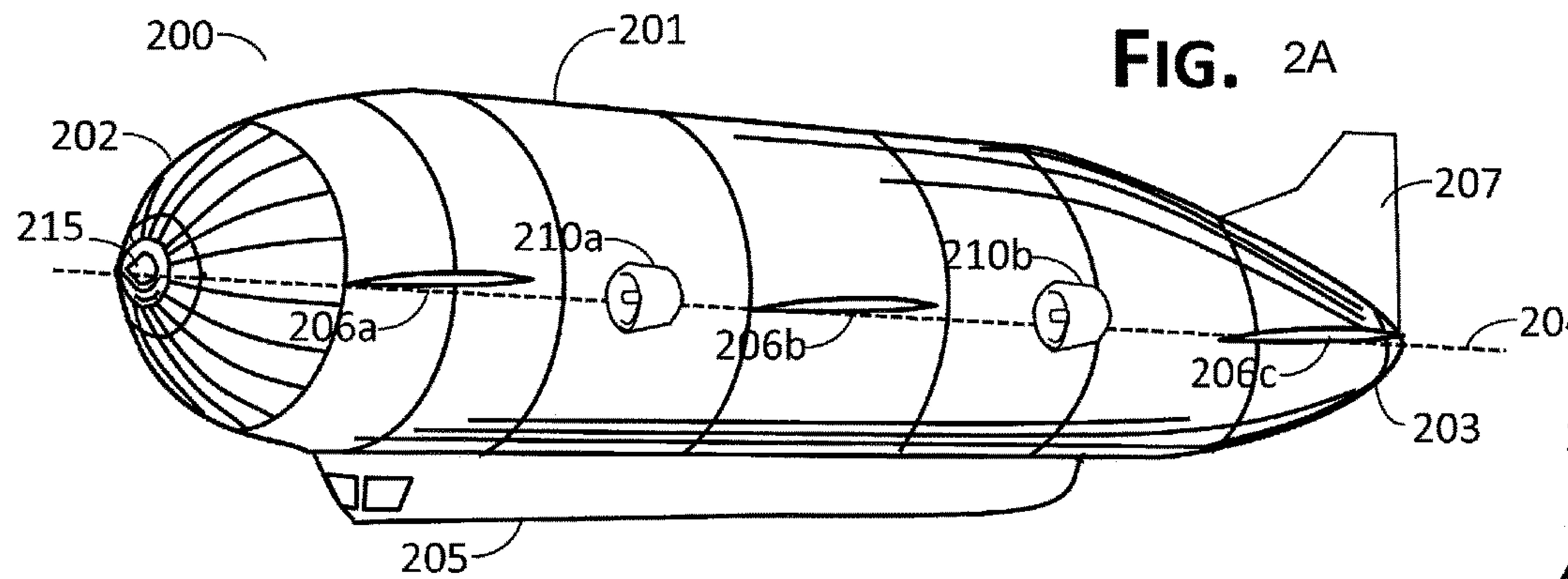


FIG. 2A

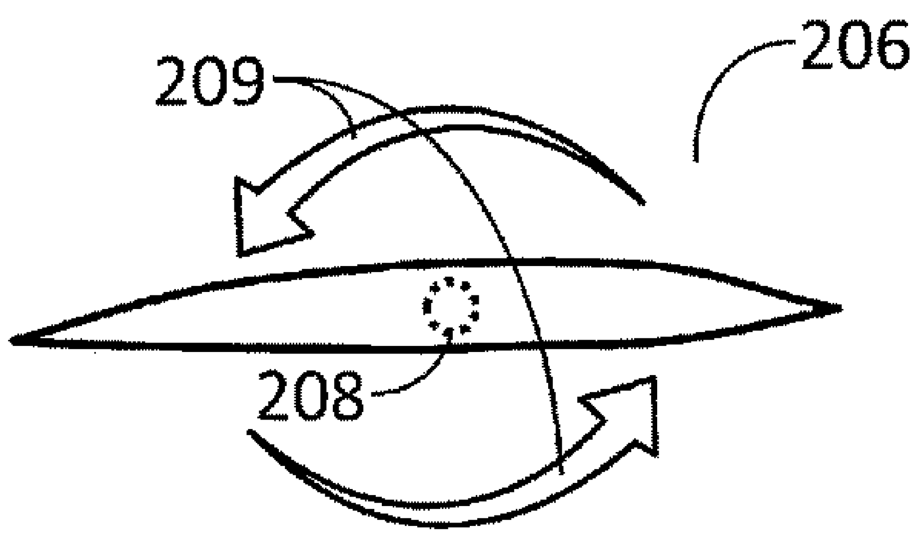


FIG. 2B

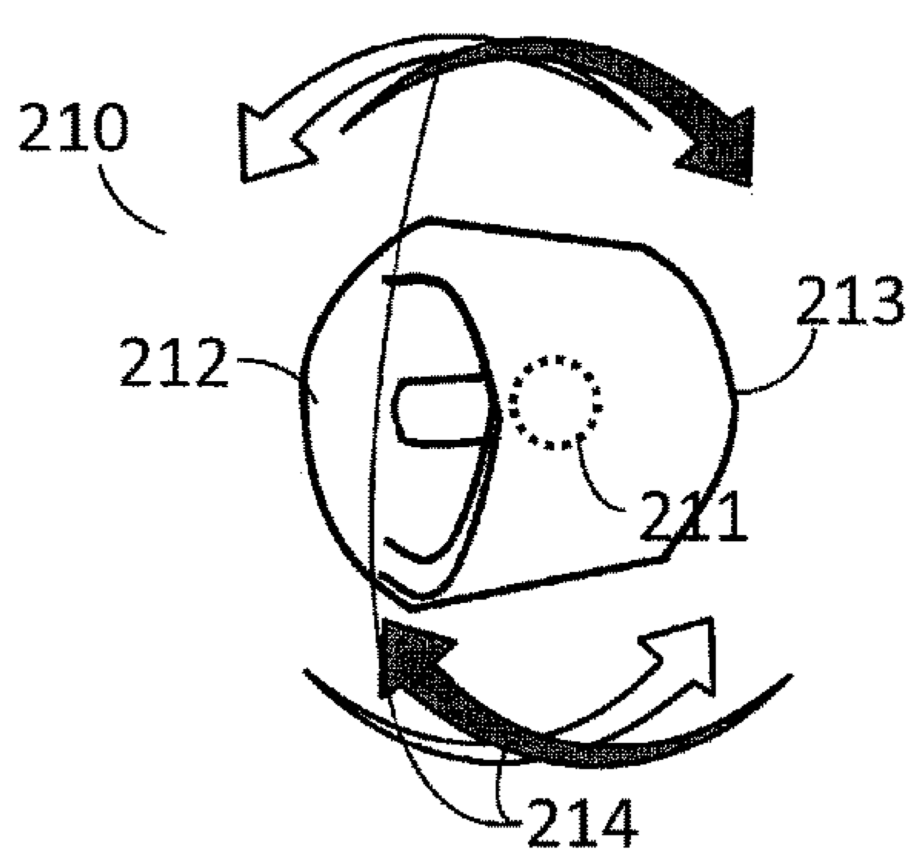


FIG. 2C

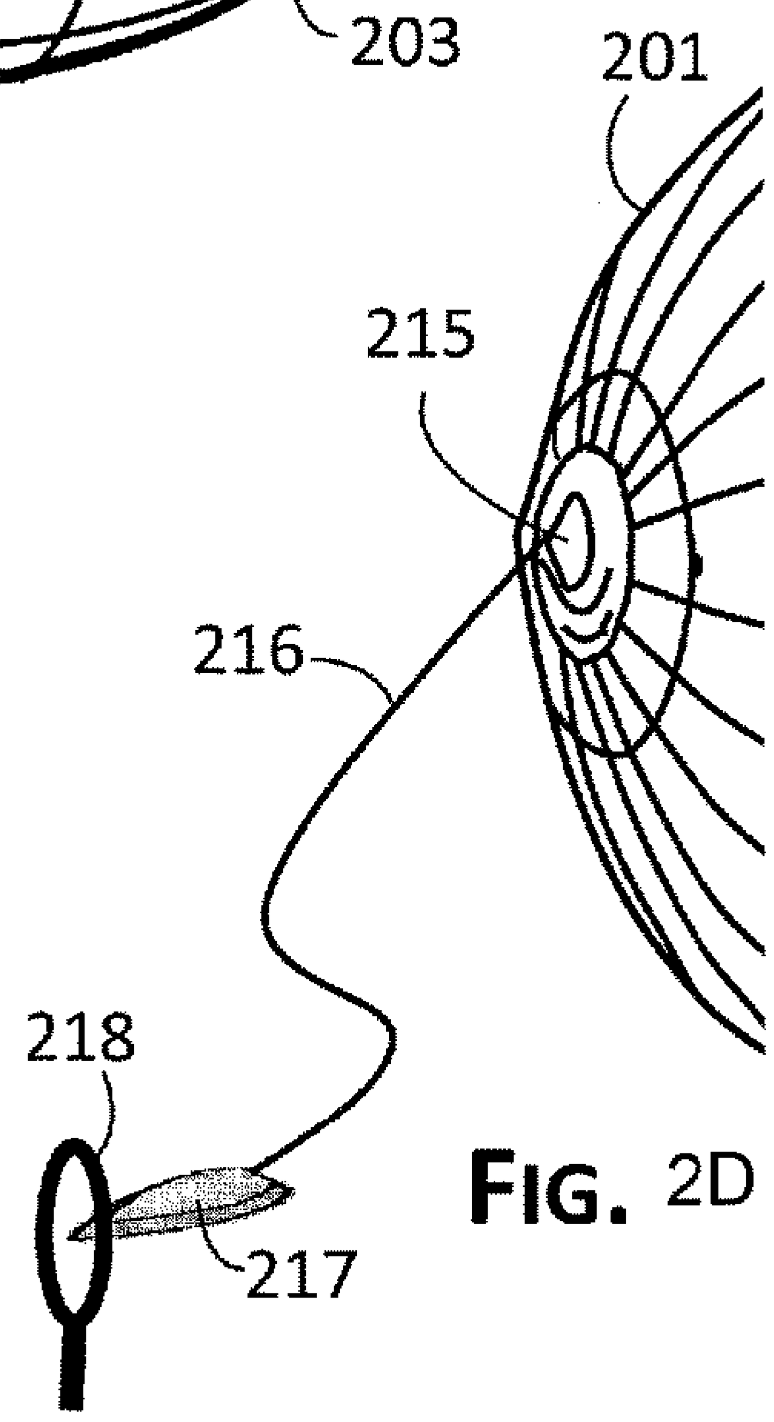


FIG. 2D

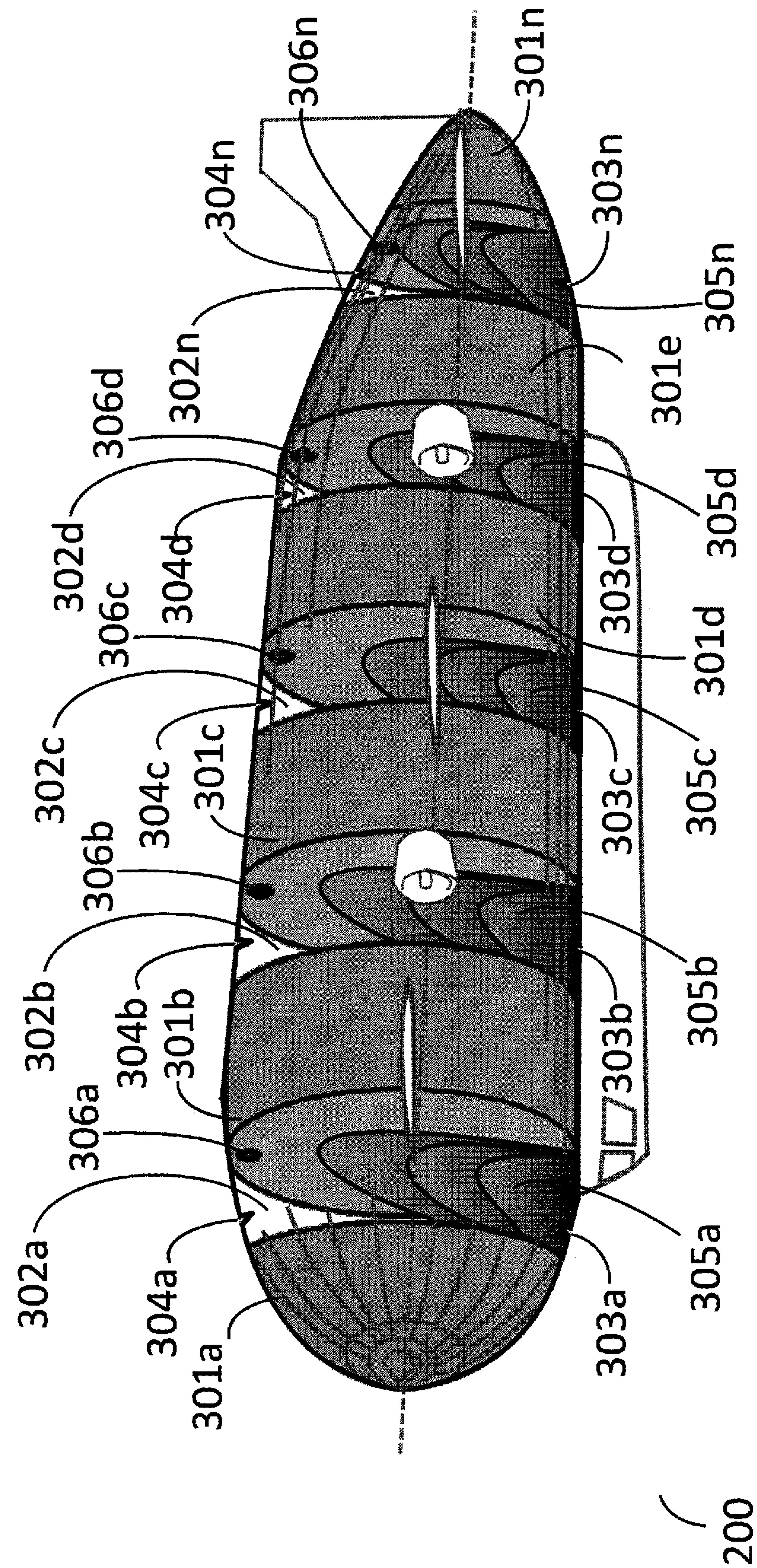

301n
306n
304n
303n
305n
302n
301e
306d
302d
304d
305d
303d
306c
301d
302c
304c
301c
303c
305c
306b
302b
304b
301b
305b
303b
306a
302a
304a
301a
303a
305a
200

FIG. 3

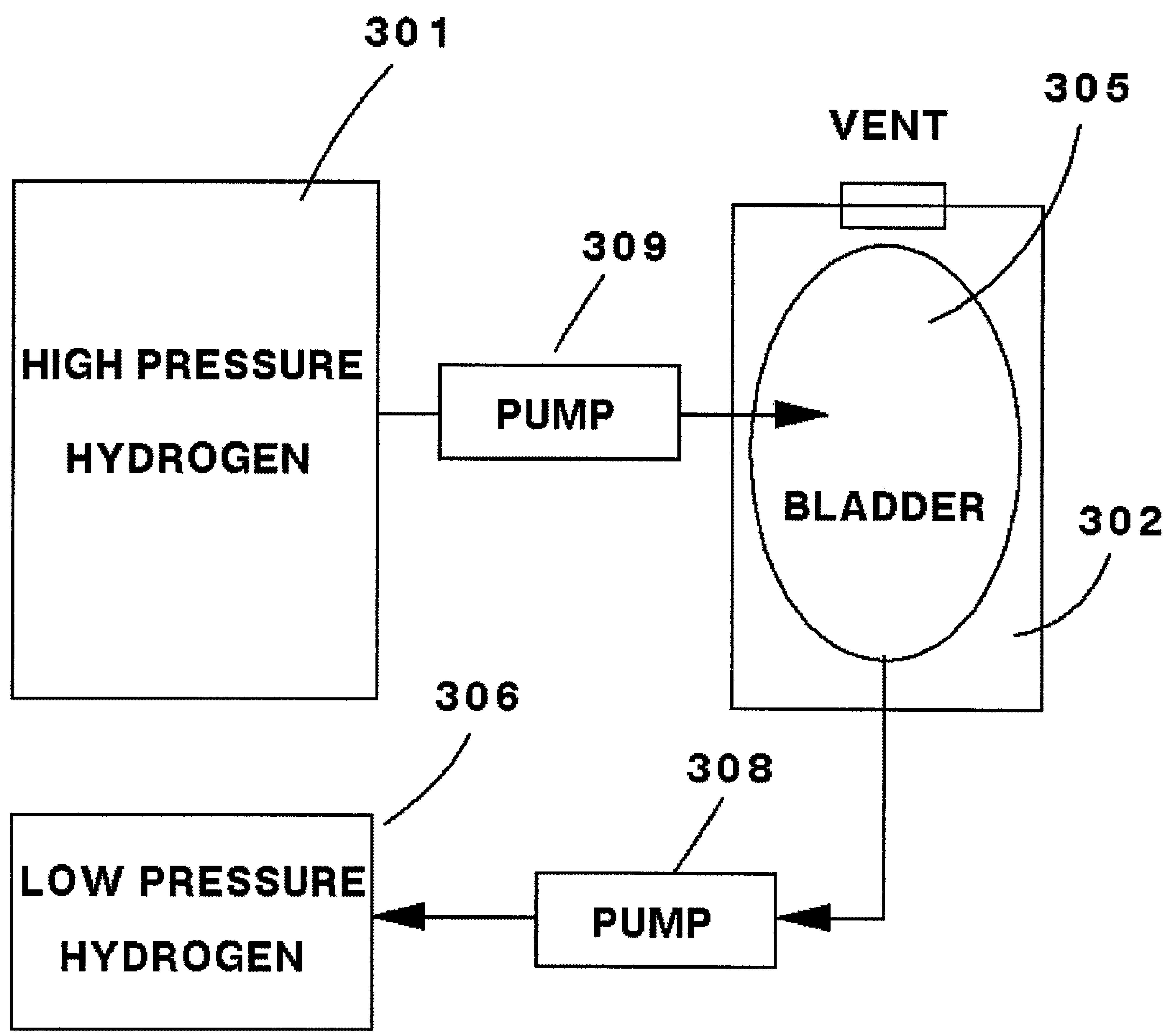

301
305
VENT
309
HIGH PRESSURE
HYDROGEN
PUMP
BLADDER
302
306
308
LOW PRESSURE
HYDROGEN
PUMP

FIG. 4

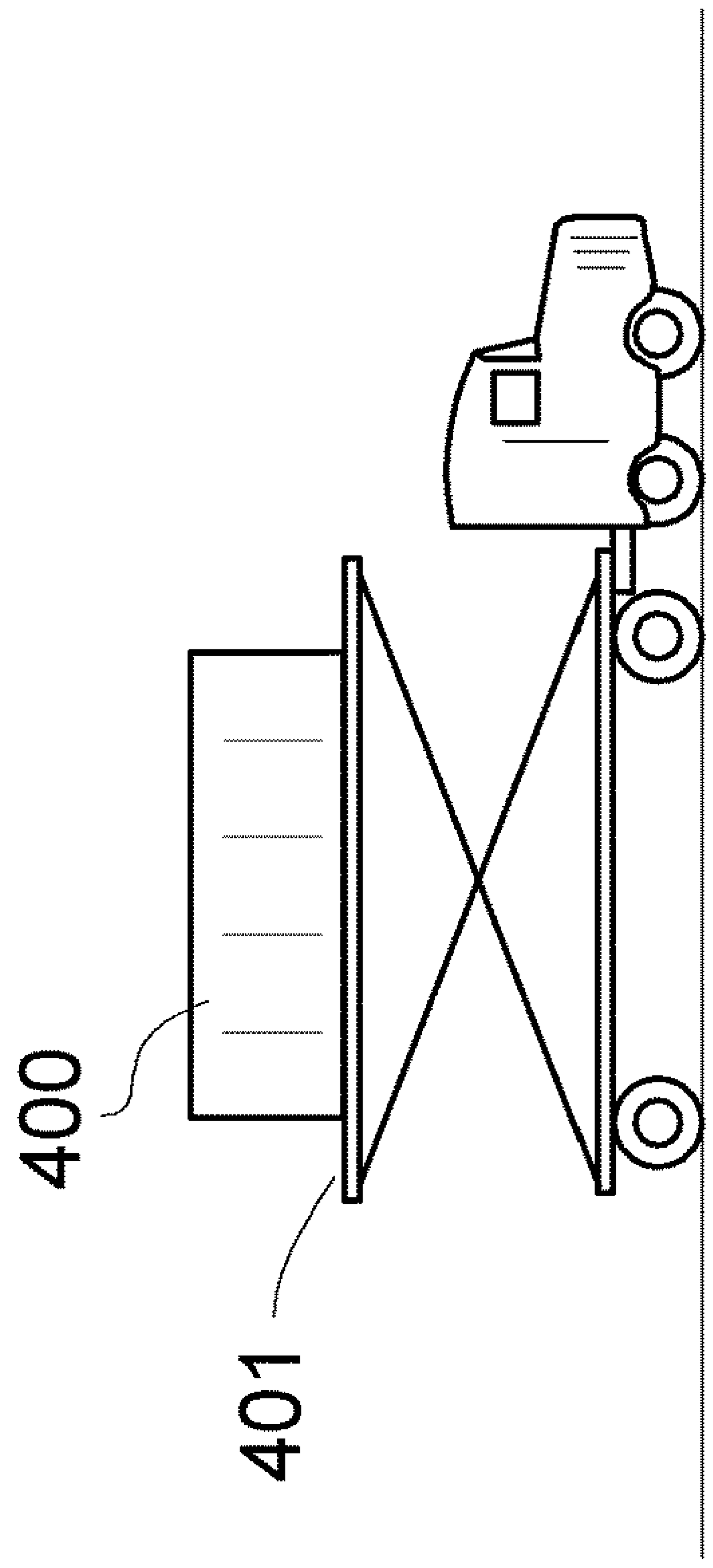


Fig. 5B

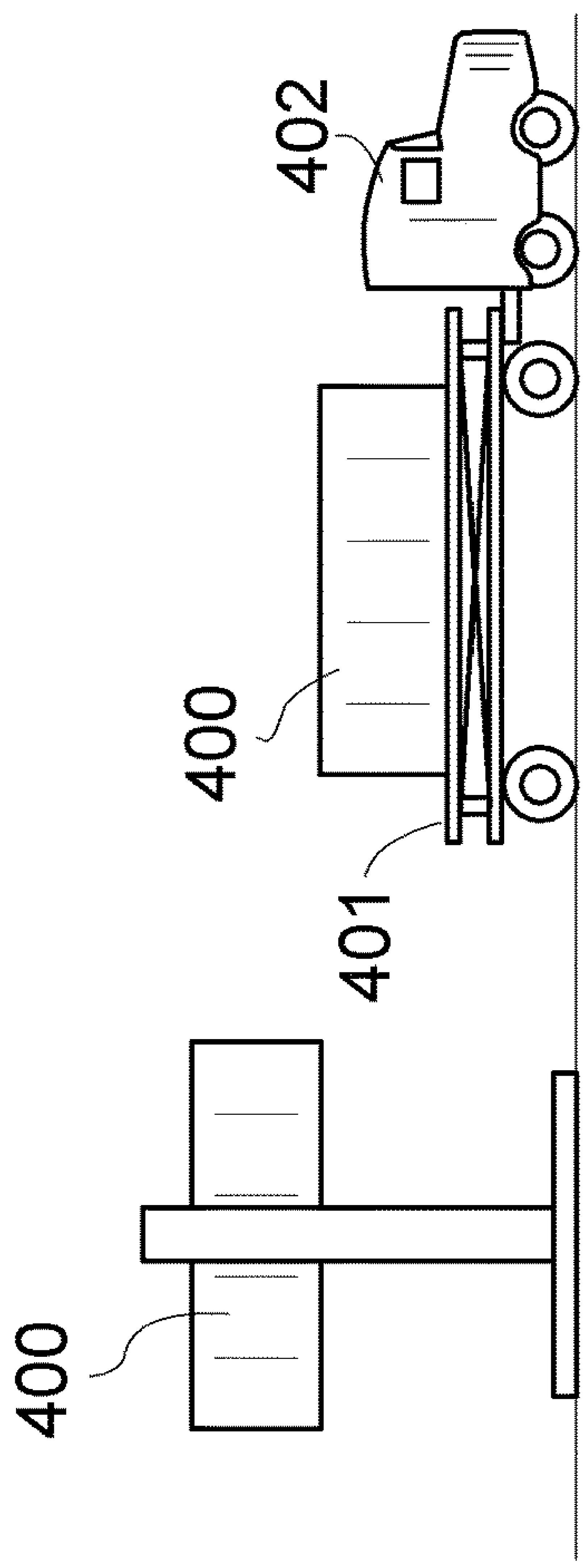


Fig. 5A

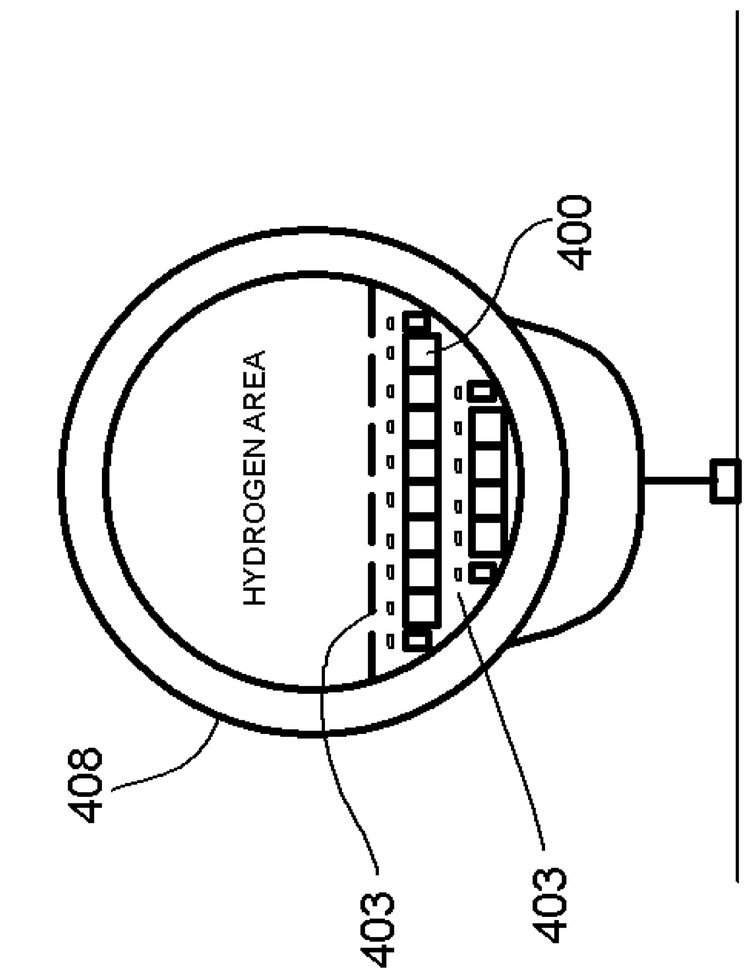

HYDROGEN AREA
400
403
403
408

Fig. 6B

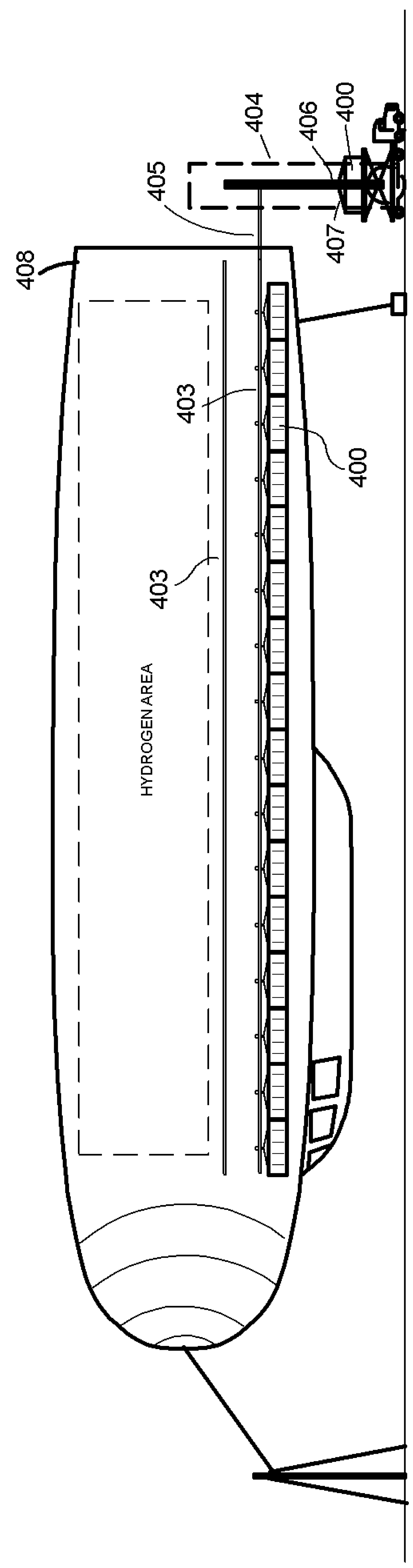

HYDROGEN AREA
400
400
403
403
404
405
406
407
408

Fig. 6A

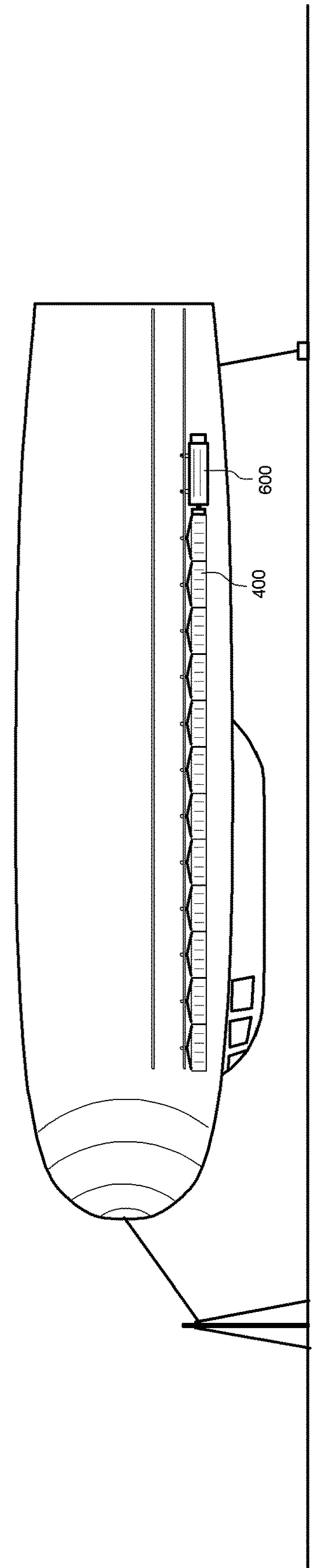


Fig. 7

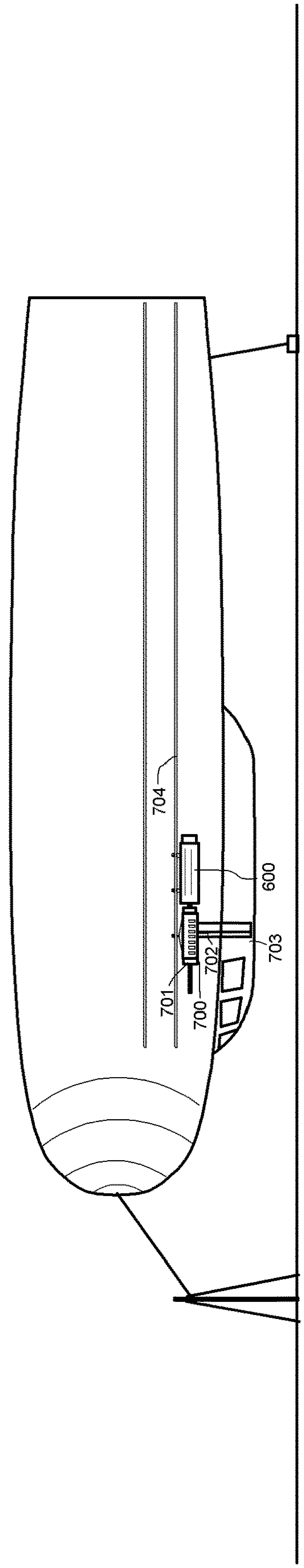


Fig. 8

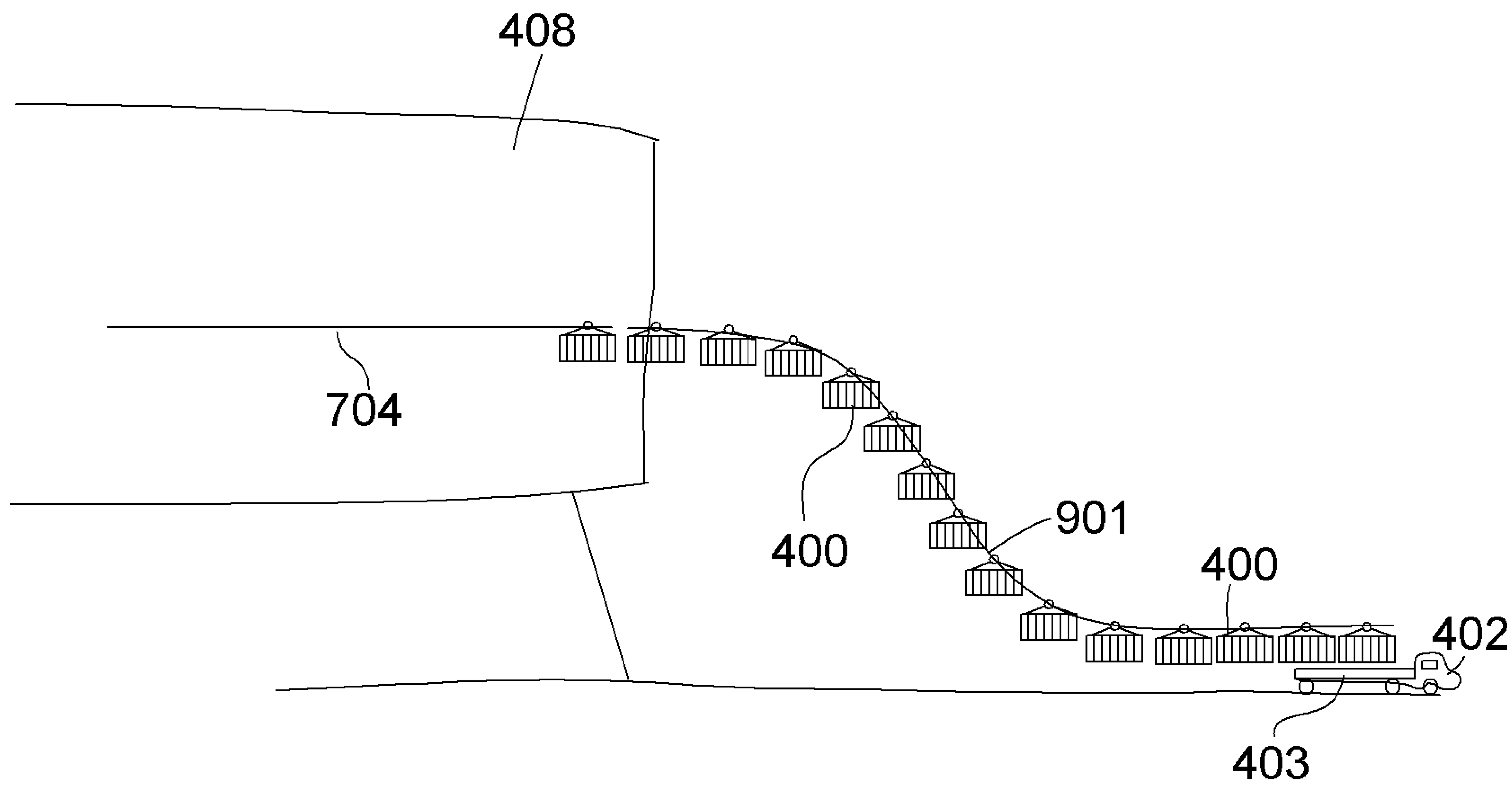


Fig. 9A

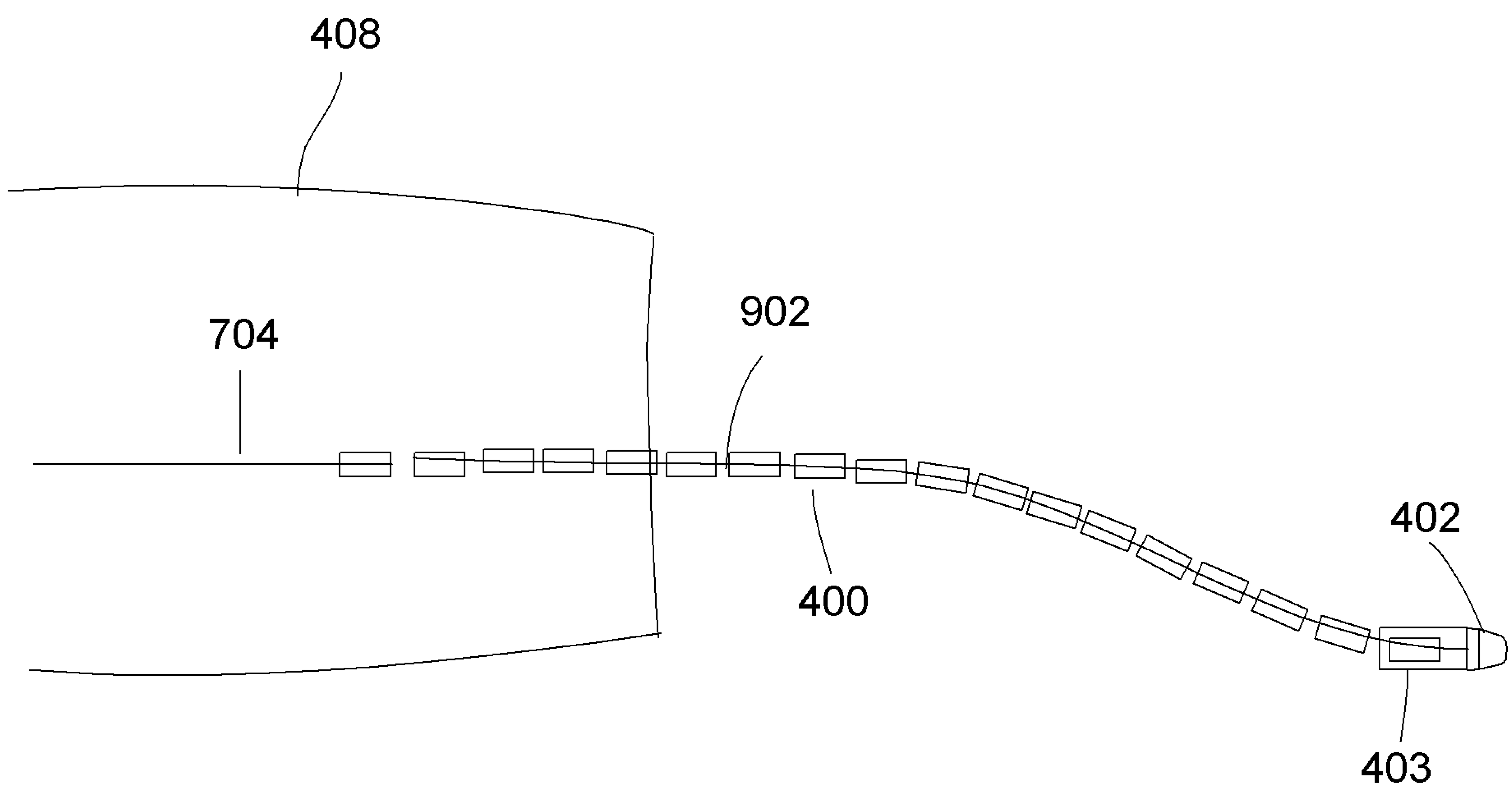


Fig. 9B

SYSTEM, METHOD AND APPARATUS FOR WIDESPREAD COMMERCIALIZATION OF HYDROGEN AS A CARBON-FREE ALTERNATIVE FUEL SOURCE

BACKGROUND

Technical Field of the Invention

The present invention relates generally to the fields of production of carbon-free alternative energy sources, transportation of gases, and aircraft design, and more particularly to a system, method and apparatus employing a specially-designed airship for transporting hydrogen from where it is generated, in a preferred embodiment via geothermal- or wind-powered electrolysis, to where the hydrogen is needed as an alternative energy source. Alternative embodiments of the invention include applications for economical transportation of cargo and passengers, as well as for transporting water to help recharge areas that are adversely impacted by the depletion of traditional glacial and snowpack sources.

Description of the Prior Art

In *Freedom from Mid-East Oil*, a book co-authored by the inventor, the case is made for the proposition that "Humanity now stands at the pinnacle of the Hydrocarbon Age, in which energy is developed by burning . . . hydrocarbons. [. . .] Hydrocarbons powered all of the advances of the Industrial Age. However, our hydrocarbons of choice—from coal and, eventually, to oil and gas—are wreaking devastation on the ecosystem. Moreover, their dwindling supply makes this form of energy increasingly less viable."

Accordingly, "the most important domestic and foreign policy challenge [we face] is achieving energy efficiency and independence from Middle East oil—and ultimately all imported oil. [. . .] Oil production is at 99% of full capacity, and . . . increased demand by China, India, and other developing nations will devour any surplus caused by U.S. efficiency measures or economic downturn, keeping oil prices relatively high. From now on, the global demand for oil will grow faster than production capacity . . . . The only nations somewhat protected from economic hardships will be those that take definitive action to achieve energy independence from fossil fuels."

"The hydrogen economy is the only reliable long-term solution to the energy and climate crises confronting civilization. There is now no other technology option that can safely produce clean energy to power transportation systems and our stationary infrastructure to sustain current levels of global prosperity, let alone increase these levels to sustain our fellow planetary citizens."

It is widely known that hydrogen is the most abundant element in the universe, and one of the most abundant on Earth, found in numerous materials including water, natural gas and biomass. In its molecular form, hydrogen can be used directly as a fuel—for example, to drive a vehicle or heat water—or indirectly to produce electricity for industrial, transport and domestic use. The huge advantage that hydrogen has over other fuels is that it is non-polluting since primarily the only by-product of its combustion is water.

Currently, the most common method for producing hydrogen is via the catalytic steam reforming of methane to produce hydrogen and carbon monoxide; and then further reforming the carbon monoxide to produce additional hydrogen, if required. However, natural gas is not a renewable source of fuel, and the steam reforming process to make hydrogen ultimately contributes to the worldwide increase in global emissions of carbon dioxide. Accordingly—although (except for unique conditions as described herein) it is currently more costly—the most promising method of producing hydrogen in the long-term is the electrolytic splitting of water (electrolysis), in which an electric current is passed through water, decomposing it into hydrogen at the negatively charged cathode and oxygen at the positive anode. If the electricity used to split the water is generated from a renewable source such as solar, wind, biomass, wave, tidal, geothermal or hydropower, then there is the potential to sustainably produce hydrogen in a non-polluting manner.

At unique locations where natural geologic or climatic conditions make it possible to economically use such renewable sources to produce electricity, the feasibility of inexpensively producing hydrogen in a non-polluting manner is being demonstrated. For example, the Big Island of Hawaii currently uses geothermal energy to produce more than 15% of its electricity and has the potential of generating 100% if it determines to do so. Hawaii has also successfully demonstrated the use of wind-generated power, and recently approved creating a demonstration project to show the technological and economic feasibility of using excess geothermal power produced during non-peak hours to create hydrogen from water, using electrolysis. This demonstration project, along with a similar project that is being undertaken in Iceland, reveal the potential for using our vast geothermal resources—a clean, renewable, continuous and reliable energy resource produced by tapping the heat stored in the Earth's crust—to produce massive quantities of hydrogen at a far lower cost and reduced environmental impact than by any other process.

However, these places where natural conditions favor the most economical access to such renewable sources for producing hydrogen in a non-polluting manner are not commonly situated in the same location where the largest demand occurs. For example, even on the Island of Hawaii itself, there are significant discrepancies between the location of the major power generators, approximately 85% of which according to a 2006 study conducted by the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, are concentrated on the eastern side of the Island, versus the locus of the Island's major population and energy consumption requirements, which occurs on its western side.

This challenge of physical separation between the location where hydrogen can be most economically produced from renewable energy sources such as geothermal, wind, wave, tidal or hydropower, and the places where it is (or is likely to be) most severely needed, is typical across the U.S. as well as globally. Accordingly, in order for this low-cost, carbon-free energy alternative to be meaningful beyond the limited number of places where, as an example, molten rock and superheated water and steam occur relatively close to the Earth's surface, will require an improved means for transporting the gas from these geologically ideal production sites to where the hydrogen is most needed as an alternative energy source, but without using high-powered transmission lines or a vast network of hydrogen gas pipelines. Similar needs exist with respect to the natural conditions that favor wind generation; or areas that favor solar, wave, tidal or hydropower-based generation. In each of these cases, nature has created features that favor comparatively low cost, clean electricity generation, the current from which can be used to electrolyze hydrogen from water. Since the technologies for creating, storing, condensing and utilizing hydrogen are well known and widely available, what is missing is a system and method of efficiently and safely transporting the hydrogen from where these natural conditions occur to where there exists a market need for this alternative energy resource.

This need for an improved method to deliver hydrogen from the place where it can be most economically produced with the least adverse environmental consequences to the place where it is needed is emphasized by a paper entitled "*The Future of the Hydrogen Economy: Bright or Bleak.*" Authored by Swiss scientists, B. Eliasson, U. Bossel and G. Taylor. This April 2003 paper (revised in February 2005) analyzes the energy needed to deliver hydrogen using a number of different methods, and concludes that the energy needed to package and deliver the gas to end users would consume most of hydrogen's energy.

In it, the authors write that "hydrogen, like any other commercial product, is subject to several stages between production and use. [. . .] Whether generated by electrolysis or by chemistry . . . the gaseous or liquid hydrogen has to undergo these market processes before it can be used by the customer. [. . .] For reasons of overall energy efficiency, packaging and transport of hydrogen should be avoided if possible. Consequently, hydrogen may play a role as local energy storage medium, but it may never become a globally traded energy commodity. [. . .] The analysis shows that transporting hydrogen gas by pipeline over thousands of kilometers would suffer large energy losses. Moreover, in practice, the demands on materials and maintenance would probably result in prohibitive levels of leakage and system costs. Furthermore, the analysis shows that compression or liquefaction of the hydrogen, and transport by trucks would incur large energy losses."

This is the commonly held perception today, and demonstrates the long-standing need for the system, method and apparatus of the present invention.

SUMMARY OF THE INVENTION

The present invention relates to efficiently transporting hydrogen from where it can be economically made to where it is most needed using specially designed airships. Technologies such as geothermal, wind, solar, wave tidal or hydropower can be used to generate electricity in-situ or very near to the primary energy sources. This electricity can then be used to produce hydrogen directly from water through various methods known in the art.

The present invention then utilizes an improved means to deliver hydrogen from the place where it is produced to the place where it is needed using an airship in which the hydrogen gas can also be used for generating lift, providing propulsion energy and serving ancillary needs. In other embodiments of the invention, the airship of the present invention can be used to dramatically reduce the cost of transportation of freight, the cost of passenger transportation, and to save on the area required for landing at the points of loading and embarkation, and unloading and debarkation. And in another embodiment, the airship of the present invention can be used for transporting water to areas that are adversely impacted by low rainfall and the depletion of traditional glacial and snowpack sources, and for transporting food and supplies from areas where such goods are plentiful to more remote areas that must import them.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block flow diagram illustrating how the system of the present invention may be used to produce and transport hydrogen from the place where the gas is generated to the area where the hydrogen is needed as an alternative energy source.

FIG. **2**A depicts an exterior side-view of an embodiment of an airship according to the present invention.

FIG. **2**B shows a possible embodiment of the mounting of a flap.

FIG. **2**C shows an embodiment of the mounting of a rotatable engine.

FIG. **2**D shows the use of a drone device to accomplish docking.

FIG. **3** is an interior side view of the airship of FIG. **2**A, showing hydrogen storage compartments and a controlled bladder system.

FIG. **4** shows a tank/bladder system.

FIG. **5**A shows an elevator truck loading a container.

FIG. **5**B shows the elevator truck in an elevated configuration.

FIG. **6**A shows a side view of container loading into a ship.

FIG. **6**B shows a rear-on view of container loading.

FIG. **7** shows a tug pushing container into the ship on a rail.

FIG. **8** shows passenger loading.

FIG. **9**A shows a side view of an alternate loading embodiment.

FIG. **9**B shows a top view of the embodiment of FIG. **9**A.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a system and method of using natural locations where the existence of geothermal, wind, solar, wave, tidal or hydropower-based conditions favor the generation of electricity that can be used to generate hydrogen from water using electrolysis, and then employing specially designed airships to transport that hydrogen gas from the location where the gas is produced to the place where it is needed as an alternative fuel source. Because the airship contains hydrogen gas, which is approximately 14 times lighter than air, the craft can carry quite a substantial payload, which in a preferred embodiment is at least a substantial quantity of hydrogen gas itself as a payload.

The craft's maneuverability in taking off, landing and changing directions is enhanced through one or more engine mounts that permit the preferably hydrogen-fueled engines to rotate and pivot so that they provide upward or downward thrust, either vertically or at an acceptable angle of ascent or descent, as well as in a lateral plane so that the engines may act like thrusters on a boat.

Turning to FIG. **1**, a block flow diagram can be seen illustrating how in one embodiment, the present invention may be used to produce and transport hydrogen from the place where natural conditions favor the clean, comparatively low cost production of electricity that can be used to generate hydrogen from water via electrolysis, to the area where the hydrogen is needed as an alternative energy source. Block **101** indicates that the first step involves the identification of a location where the natural conditions or features favor comparatively low cost, clean electricity generation.

There are a number of places where such favorable natural conditions are present. These include places where substantial electricity is presently being generated on a commercial scale, such as in Hawaii, Iceland and Northern California, where molten rock and superheated water and steam occur relatively close to the Earth's surface, or where adequate heat can be tapped such that injected water to the heat source can economically generate electricity, in each such case thereby favoring geothermal production of hydrogen from such electricity in a preferred embodiment of the invention In other embodiments, the location may rely upon favorable conditions for wind generation, such as along the North Sea, the southern tip of South America, the Australian island of Tasmania, and certain locations in North America where relatively continuous high wind velocity is present. Alternatively, it may relate to ideal solar conditions, such as in the Pacific Ocean, south of Hawaii, in the Sahara, the nation of Niger, and certain parts of Australia; as well as locations that are ideally suited to power generation from wave energy, tidal flow production, and hydropower, which power is then converted into hydrogen.

Block **102** indicates that at one or more of these locations where nature has created features that favor comparatively low cost, clean electricity generation, known technologies are used to generate hydrogen from water using electrolysis. Block **103** illustrates that the hydrogen gas generated by this means will be temporarily stored on site or in close proximity to where it is produced, pending the arrival of a suitable transport vehicle. In step **104**, the hydrogen is transported from the place where these natural resources occur—which is often in a relatively remote location—to places where there is a market need for this alternative energy source.

As illustrated by blocks **104***a* through **104***d*, the preferred method of transporting the hydrogen uses the hydrogen itself to provide propulsion energy for the craft, **104***a*; and takes advantage of the lighter-than-air quality of the gas to provide lift, **104***b*, thereby materially reducing the energy needed for transporting the payload. Additionally, the preferred method for transporting the hydrogen also utilizes the hydrogen for all on-board electrical ancillary needs, **104***c*. Accordingly, through practicing the present invention, the excess hydrogen, **104***d*, can be delivered to the location where the gas is needed as an alternative energy source with little to no carbon-fuel consumption. In a preferred embodiment of the invention, these attributes are fulfilled by a specially designed airship **200** such as described with regard to FIG. **2**, below.

Once at the desired destination, the excess hydrogen, **104***d*, can be moved off the airship to storage, illustrated by block **105**. From this storage location, the hydrogen can be combusted at an electricity generating plant or distributed to other end use locations using conventional means such as pressurized and non-pressurized portable containers and pipelines, illustrated by block **106**, to both resellers and/or end users of the clean energy source. This step is in turn illustrated by block **107**. Block **108**, entitled "Lighter-than-air vehicle usage for transportation of cargo payload on return flight," illustrates another principle of one preferred embodiment, which involves utilizing the craft's return flights for the purpose of carrying passengers and/or a cargo payload, as illustrated by line **109**, particularly where such payload may be useful to fulfilling particular needs associated with the location of the natural features that favor low cost clean electricity generation referenced in block **101**. In particular, a return flight (or any flight) can carry water, food or other cargo necessary for life from a location where it is abundant to a location where it is needed.

Turning next to FIG. **2**A, it will be observed that FIG. **2**A depicts an exterior side view of an embodiment of an airship **200** according to the present invention. The airship **200** preferably includes an exterior shell **201** having a front portion **202**, a rear portion **203** and a main axis **204**. According to one embodiment of the airship **200**, the exterior skin **201** may be made from a carbon fiber composite, film laminate or an equivalent material such as KEVLAR™ or other high-strength ballistic nylon, and/or may be coated with fluorocarbon polymer such as TEFLON™ or other similar materials that will minimize the overall weight of craft **200** while at the same time providing a protective outer coating and minimal air resistance. KEVLAR and TEFLON are registered trademarks belonging to the DuPont Corporation of Wilmington Del. Any material with suitable properties for forming an exterior skin is within the scope of the present invention.

Bodies that generate lift, and/or the term lifting bodies, refers to an aircraft configuration where the body of the craft itself (with or without wings) produces lift, such as a fuselage that generates lift without the shape of a typical thin and flat wing structure. Lifting bodies generally minimize the drag and structure of a wing, and provide the best trade-off in terms of maneuverability and aerodynamics. Thus, in a preferred embodiment, the exterior shape of airship **200** will be designed to apply the principles of lifting bodies to conventional dirigible design.

FIG. **2**A also shows one or more optional external flaps, **206***a* and **206***b*, located on each side of the craft along main axis **204**; and **206***c* at the rear that can function as an elevator flap. Additionally, one or more optional single rudder, dual rudders or other stabilization methodologies, collectively **207**, are located at the rear of the craft or other appropriate locations for enhancing stability and in order to help steer the craft. As illustrated in FIG. **2**B, each external flap **206** is preferably mounted so that it can be rotated around a pivot **208**, and raised or lowered according to arrows **209** in order to provide additional lift during ascent and stability during descent of the craft.

In a particular embodiment of the present invention, the airship **200** may further include one or more external motors, **210**, which may be a jet, turbojet, rotary blade, or propeller-type engine that is preferably powered by hydrogen as its energy source (but in alternative embodiments that may be powered by jet fuel, gasoline, diesel or electricity, including from solar cells mounted on the craft's exterior). According to the embodiment illustrated in FIG. **2**A, external motors **210** may be mounted along the main axis **204**, or optionally may be attached to the gondola **205**, to one of more or external flaps **206**, or to the rear portion **203** of exterior shell **201**.

Another advantage of the airship **200** is that, as illustrated in FIG. **2**C, each external engine **210**, can be optionally mounted so that it can be rotated around one or more pivots **211**, and turned according to arrows **214**. This optional feature will permit external engines **210** to be turned so that the leading edge of the engine **212** can be directed along the main axis **204**, perpendicular to that axis for take-off or landing, and at any angle to help speed ascent or descent of the craft. Additionally, in a particular embodiment, external engines **210** may be rotated laterally with the rear edge of the engine **213** directed away from the craft, to help maneuver the airship sideways in the manner achieved by thruster engines in a boat.

The exterior of the craft **201** may be formed of a substantially rigid material such as carbon fiber or any other suitable light weight material; or alternatively any number of readily available flexible and/or microfiber-based composite materials; or any other hydrogen and helium retentive materials. Although in an alternative embodiment, lighter-than-air craft **200** may employ a semi-rigid design (e.g., employing some internal support such as a fixed keel), in a preferred embodiment, the craft can employ a rigid (e.g., with full skeleton) design. However, unlike the rigid design of older airships such as the Zeppelin, which were constructed with steel members, the internal structural elements employed in carrying out the design for airship **200** will preferably employ materials having the dual qualities of being lightweight and extremely strong, such as carbon fiber or nanotubes, graphite, aluminum and various composite materials that are well known in modern aeronautical design. Any material that is structurally strong and also light is within the scope of the present invention.

One of the historical challenges of operating a lighter-than-air craft is to control the ship's landing, particularly in cases where the landing area is tight and/or where weather conditions such as high winds in or near the landing area may make it exceedingly difficult to control a craft having such a large surface area. In order to overcome this challenge, FIG. **2**A depicts that the lighter-than-air craft **200** can include a reinforced connector **215** for a lightweight guide-wire cable or tie-line. This optional feature is further illustrated in FIG. **2**D, which shows that guide-wire cable **216** may be physically attached to connector **215** at an appropriate point at or near the front of craft **200**.

A pole higher than at least half the diameter of the craft can be equipped with a gimble on its top that can swivel to any angle. The attachment point **218** can be mechanically coupled to this gimble. Once the lightweight guide-wire **216** engages the attachment **218**, a larger diameter tie cable can be fed through the attachment **218**. The craft can then be reeled in and tied to the gimble so that it can align itself with the prevailing wind much as a sailboat on an anchor. The aft end of the craft can then be stabilized, either with an additional tie-down or with another pole.

In order to direct the first guide-wire **216** into the attachment **218**, a small, remotely controlled unmanned, aerial vehicle (also known as a "UAV" or "drone" craft) or a projectile fired from the airship for the same purpose, such as illustrated by craft **217** may be attached to the other end of guide-wire cable **216**; and such UAV may be flown to the landing area where guide-wire **216** can be tied to stationary curb **218**, and a hoist (not shown) may used by ground personnel to reel-in and safely secure craft **200**. The UAV craft may be flown by wireless techniques such as radio or light, or by fly-by-wire where electrical signals are sent to it using either a small electrical cable that runs along the guide-wire **216** (or that is the guide-wire), or by using a fiber optic cable that runs with the guide-wire **216** (or is the guide-wire). The UAV craft may be piloted from a remote console by the dirigible's pilot or a landing officer. The drone **217** could be made maneuverable using airfoils and powered with a small engine, all as is known in the art. The drone **217** or projectile could contain a video camera, radar or other sensing or navigation device such as GPS. The drone **217** can be configured to hover or fly straight as needed for docking the larger craft. A fired projectile, on the other hand, could be fired into a receiving port that could optionally be equipped with an electromagnetic field. While several methods and techniques for tethering and docking the large craft have been presented, any method of docking or attaching the craft to a tie-down or support is within the scope of the present invention.

FIG. **2**A shows an embodiment of the lighter-than-air craft of the present invention. Many other shapes are possible. In some embodiments, the craft can be cigar-shaped with a pointed or "needle" nose. The craft can also have a sharply tapering tail. Designs with these features typically have lower drag coefficients that result in higher speeds with lighter engines. To increase the payload on such a design, the craft can be lengthened. FIG. **2**A also shows the craft with a gondola **205**. The use of a gondola is optional to carry crew, passengers or cargo. In some embodiments of the present invention, all of the payload can be carried in a gondola. In other designs, the craft may have no gondola or a small gondola simply for crew with all most or all the payload being carried inside the main hull. A gondola **205**, if used, may be pressurized for high altitude flight (typically flights above 14,000 feet above sea level will require pressurization).

Now turning to FIG. **3**, an interior side view of the embodiment of the airship **200** shown in FIG. **2** can be seen. Inside the craft, one or more hydrogen storage compartments **301***a*-**301***n*, are preferably alternated with at least one or more chambers or compartments **302***a*-**302***n*. The hydrogen storage compartments can **301***a*-**301***n* can be high pressure storage tanks or other storage devices. Thus, whereas the traditional lighter-than-air craft may use a suspended structure generally corresponding to gondola area **205** shown in FIG. **2**A for carrying its payload (a technique that can be used with the present invention), in many embodiments of the present invention, storage compartments or tanks **301***a*-**301***n* are able to be filled with hydrogen, preferably in either a compressed or liquefied form as a payload. Chambers or compartments **302***a*-**302***n* can contain a system of bladders **305***a*-**305***n* that are able to be filled with hydrogen or helium to afford the additional lift needed to achieve buoyancy once at the desired flight altitude.

Each of chambers **302***a*-**302***n* generally includes an inlet valve or vent, **303***a*-**303***n*, and an outlet valve or vent, **304***a*-**304***n*, respectively; however, in many embodiments of the invention, these may be the same, and there may only be one set of openings or vents. The housing of chambers **302***a*-**302***n* may consist merely of the exterior walls of hydrogen storage compartments **301***a*-**301***n* and the interior walls of shell **201**; however, it is also possible that they can be constructed from a separate flexible liner made of appropriate microfiber-based composite materials or other hydrogen and helium retentive material. As shown in FIG. **3**, a bladder system **305***a*-**305***n* can be disposed inside chambers **302***a*-**302***n*, respectively, to divide the portion of each such chamber served by the valves or vents. These bladders can be made of flexible microfiber-based composite materials or any other hydrogen and helium retentive materials, but in alternative embodiments may be plates or bags made of polyvinyl chloride, polypropylene, or any other suitable materials. Any hydrogen or helium retentive material may be used to construct the bladder system and is within the scope of the present invention. The bladders **305***a*-**305***n*, in effect, can act as inflatable bags or accordion type structures using fixed elements and flexible material.

Generally, each set of compartments **301***a*-**301***n* can contain at least one high pressure hydrogen tank **301** (as is also shown in FIG. **4**) while compartments **302***a*-**302***n* can contain one or more bladders **305***a*-**305***n*. One or more, lower pressure hydrogen tanks **306** can be connected to the outlet of each bladder. When additional lift or trim is desired, high pressure hydrogen can be vented or pumped **309** from a high pressure tank into a particular bladder **305** expanding it. As the bladder **305** expands in the compartment or chamber **302**, air at ambient pressure is forced out of the compartment. When less lift is desired, a pump **308** can take hydrogen out of the bladder **305** causing the bladder to collapse and force it into the second, lower pressure hydrogen tank **306**. In this manner, no hydrogen is mixed with air, vented or wasted. The low pressure hydrogen can simply be saved in the lower pressure tank, transferred to another tank, ducted to engines to as a fuel, or it can be pumped back into the high pressure tank using a second, high pressure pump. As a bladder collapses, air at ambient pressure is drawn in from outside the craft. In an alternative embodiment, the excess hydrogen can also simply be vented to the atmosphere.

The bladder system described can selectively increase or decrease the ratio of hydrogen to air in the chambers **302** to control the amount of lift the craft achieves at every altitude while ascending and descending taking into consideration the changing atmospheric pressure that naturally occurs when a craft ascends and descends. This feature can be controlled automatically by a computer program running on a typical computer, server or other processor known in the art which can simultaneously monitor external ambient pressure based upon the altitude of the ship, the desired direction and speed of ascent or descent, and the lift being achieved, so as to optimize the flow of hydrogen to and from one or more bladder or accordion chambers.

The unique configuration of these chambers or compartments, the flexible bladder system and available hydrogen supply will, in conjunction with the outside engines **210**, airfoils and the optional computer control, permit the bladder system to be used to adjust the quantity and pressure of the hydrogen or helium gas in the chambers to be sufficient for the overall weight of the craft and its payload (including compressed or liquefied hydrogen in storage tanks) and the desired rate of climb to altitude, descent from altitude, and/or maintaining relatively neutral buoyancy once the desired flight altitude is attained.

The bladder system described allows simultaneous control of both lift and fore-aft trim. When the craft is not moving horizontally, adjustment of bladders in different parts of the ship allow trim control. After the craft acquires a horizontal speed, trim can also be controlled by the airfoils and engine directions as described. At altitude and speed, the bladders can be set to achieve approximately neutral buoyancy with trim and with part of the lift then being provided by the structure itself according to aeronautical principles with trim being almost exclusively controlled by the airfoils and the engine directions. In general, the craft of the present invention ascends and descends at relatively slow horizontal speeds relying on buoyancy control and moves at high horizontal speeds at altitude for long distance travel relying on airfoils and engines for thrust and/or control.

In accordance with the principles of the invention, the foregoing system, method and apparatus is capable of lifting an enormous amount of weight—on the order of 100 tons (200,000 lbs.) or more—and of transporting its payload of hydrogen or other cargo over long distances to where it is needed with comparatively low cost with negligible to no consumption of carbon-based fuel, and at a speed that is many times faster than via ocean tanker. The craft of the present invention may travel at speeds as high as several hundred miles per hour at high altitudes.

The present invention has many advantages over the prior art including the fact that the airship is able to land on an area that is only slightly larger than the size of the craft itself and to take off again with only modest ground facilities or refueling. Another advantage is that once the maximum capacity (by volume) of hydrogen storage tanks **301***a*-**301***n* is reached, the additional lifting capacity of airship **200** may be used to carry a payload of freight and/or passengers in gondola area **205** at nearly zero incremental cost. Yet another advantage is that rather than being required to "dead-head" return flights, merely by filling hydrogen storage tanks **301***a*-**301***n* and chambers **302***a*-**302***n* with a sufficient quantity of hydrogen or helium for the return flight, such flights may be used in a conventional fashion, either for freight or passenger transit using gondola **205** and any cabins or storage holds built into this area.

In another embodiment of the present invention, some portion or all of storage compartments **301***a*-**301***n* may be specially adapted to be filled with water. So outfitted, the ship may be utilized counter-cyclical to its use for transporting hydrogen as previously described for moving large quantities of water, such as in connection with areas where climate change has reduced runoff from traditional snowpack or glaciers. In these cases, the airship may be used to serve upstream locations for which there presently exists no economic means of reverse-gravity flow. In such instances, the flexible bladder system of the instant invention or the cylinders dedicated to compressed hydrogen used in other embodiments can be adapted for the purpose of holding large quantities of water or other liquids.

The present invention is very versatile for widespread commercialization of hydrogen as a carbon-free alternative fuel source in that it can be tailored to accommodate numerous different operations. Thus, for example, whereas a particular embodiment may entail the use of the craft to economically transport payloads of water, the lighter-than-air ship may also be used to transport various cargo payloads. Hence, in the case of the foregoing example of Hawaii, an island blessed with geothermal and wind resources that may fuel the production of hydrogen that could be transported to California for use, on the return flight, the ship may be used to transport tourists and/or large quantities of food and paper goods that are presently being shipped from California to Hawaii. This practice may be applied in any number of ways that is tailored to the particular socio-economic and political-geographic needs.

Several examples will now be presented in order to illustrate the concepts of the present invention. The scope of the present invention is not limited to the numbers or quantities expressed in these examples. Straight hydrogen gas lift will be first considered, followed by the power required to achieve high speeds at altitude. Simplifying assumptions will be made.

As part of the first example, consider an airship according to the present invention designed to lift a maximum weight of 400,000 lbs.; cruise at an altitude of 39,000 feet; and maintain a maximum speed of 100 MPH at that altitude. Assume the craft has the shape shown in FIG. **1** with a maximum diameter of 300 feet and a length of 1700 feet. For simplicity in this example, this will be considered to be a cylinder of these dimensions. The volume of such a cylinder is 120,165,919 cubic feet, or approximately 3,402,720 cubic meters.

Air at sea level has a density of around 1.225 kg/cu meter, and at 39,000 feet, a density of around 0.316406 kg/cu meter according to the standard atmosphere model. Thus, at sea level, 3,402,720 cu. meters of air weighs about 4,168,332 kg, and at 39,000 feet, it weighs about 1,076,641 kg. It is well known that a body possesses lift (positive buoyancy) when the weight of its displacement is greater than its total weight. The total lift force is the weight of its displacement of air minus the total weight.

Molecular hydrogen gas has a density of around 0.08988 kg/cu meter. Thus, if the entire cylinder was filled with hydrogen gas, the gas would weigh about 305,836 kg. The lift at sea level would be 3,862,496 kg and at 39,000 feet 770,805 kg. This results in a lift of 8,515,339 lbs. at sea level and 1,699,332 lbs. at 39,000 feet for the example given.

Of course, the ship is not a cylinder as assumed in this example, and the entire structure would not be filled with hydrogen gas. However, it can be seen that even neglecting these simplifying assumptions, at altitudes much greater than 39,000 feet, there is entirely adequate gas lift using this size ship for a total craft weight, including payload, of 400,000 lbs. or greater.

The next example will consider speed at altitude, again 39,000 feet for this particular case. It is well known that to maintain a particular speed in a fluid, the thrust force must equal the drag force. Drag force is equal to ½ times the drag coefficient times the density times the cross-sectional area times the speed squared. Thus drag, and hence required thrust, increases (or decreases) linearly with density and area, and quadratically with speed.

The drag coefficient is independent of area, density or speed and is related only to the type of flow and the shape of the body. Since the air density at 39,000 feet is thin, the assumption will be made that the type of flow is laminar with a boundary layer. The drag coefficient for a bullet slug shaped object (both ends) in this type of flow is around 0.3 (in contrast, an extremely aerodynamic airfoil at zero angle of attack has a drag coefficient of around 0.045). If the object is made narrower (more cigar-shaped), the drag coefficient decreases significantly.

Again, assuming a diameter of 300 feet (or radius of 45.72 meters) with a double bullet shape, the cross-sectional area is about 6,467 sq. meters. 100 MPH is 45 meters/second. Using the density of air at 39,000 feet from the standard atmosphere of 0.316406 kg/cu meter, the drag force is 622,860 Newtons, or 140,024 lbs. This thrust could be supplied by several conventional jet engines.

Much higher speeds can be attained with a cigar-shaped craft. Consider again for example a cigar-shaped craft of 100 feet in diameter with a friction coefficient of 0.17. In this case, the thrust required to maintain 350 MPH is 108,000 lbs. This could be supplied by several conventional jet engines. A craft 100 feet in diameter with a length of 4000 feet configured as a cylinder totally filed with hydrogen could lift 2,226,232 lbs. at sea level and 444,269 lbs at 39,000 feet. Thus, in this example, a speed of 350 MPH is attained at altitude while still lifting 222 tons of total weight to that altitude. A pointed or "needle" nose and tail would add further to the aerodynamic efficiency.

The above-discussed examples clearly show the feasibility of constructing a hydrogen carrying craft that could lift 100 tons to 39,000 feet and maintain 300 MPH at that altitude with only two engines. The examples show an abundant lift capacity to lift the weight of the engines and payload as well as the structural weight of the proposed craft.

As stated, in the preferred embodiment of the present invention, the engines in the preferred embodiment burn hydrogen (perhaps from a tank of highly compressed or liquefied gas). The engines can also run on non-conventional fuel such as hydrozine. Such engines are generally much lighter than a conventional jet engine and will provide adequate thrust for the craft of the present invention. Total drag can be minimized by reducing the diameter of the craft, using a pointed nose and possibly tail. The payload carrying capability can then be increased by lengthening the craft. The craft can thus be lengthened (within the bounds of structural stability) to tradeoff payload carrying capacity against engine and possibly fuel weight.

An alternative embodiment of the present invention is where the outside surfaces **400** of the airship includes numerous solar cells **401** that can be mounted individually or belong to a series of panels. These solar cells can be used to power electric motors **402** and other equipment aboard the ship. Typically, the solar cells **401** charge a battery or system of batteries in order to provide a constant source of electric power. This embodiment can use the hydrogen or helium bladder system previously described with pump motors being powered by energy from the solar cells. In this system lift gas is released into inflatable bladders to provide lift for the ship. When less lift is needed, the gas from the bladders is recovered and stored in a low pressure storage system.

The lighter-than-air ship previously described requires a method of loading and unloading cargo and passengers. While there are many known ways of carrying cargo in a vessel, the preferred technology of the present invention is a system of parallel rails located in rows at various heights in the airship hull that receive and hold cargo containers by suspension from a rail wheel in a gondola fashion. The rails typically run the length of the hull fore and aft. Containers, which can be the same size as standard cargo container used in commercial shipping, are raised into position at base of the hull and there grasped by a lifting device such as a crane. They can then be lifted to the desired rail level and manipulated horizontally to the correct final rail. They are then suspended from that rail, and moved forward into the hull along the rail. Container after container can be loaded this way, until the rails in the hull are fully loaded or there are no more containers to load.

Typical shipping containers are 40 feet long and 10 feet wide. A container can be moved from a ground location on a special vehicle to a loading position below the level of the open hull of the airship. The special vehicle can then optionally elevate the container into the loading position near or somewhat below the height of the lower margin of the hull. The vehicle can be of the type that can elevate its payload to different vertical positions. An example of this type of vehicle is the well-known passenger transport vehicles used at Dulles Airport in the United States. The container is placed on the vehicle using a standard container crane at a staging area. At this point the vehicle elevation system is at its lowest level. The vehicle then drives the container to a predetermined hull loading position, and elevates it toward the hull opening. The container can be equipped with slots at its four corners.

Once in vertical position, a special crane device attaches hooks to the four corners of the container that terminate with cables into one or more rail wheels. The crane then manipulates the rail wheel and container vertically and horizontally to the termination of the desired rail. The wheel is engaged with the rail and the container is then moved onto the rail and suspended from it. A rail tug device or other device then moves the container forward into the hull along the rail to its final position where it can be secured for transport. The containers thus ride end-to-end along each rail. Depending upon the particular size of the airship, as many is fifty or more rails can be accommodated allowing numerous containers to be loaded.

In an optional embodiment in lieu of, or as an enhancement to such special vehicle, a separate loading line can be provided to enable a change in elevation between the bed of the truck or train on which they are delivered to the embarkation area, and in yet a third optional embodiment to create a queue of pre-positioned containers for loading onto the lighter than aircraft in a single operation. Similar to the loading area of a gondola at ski resorts, in such optional configurations, this side line will enable much of the logistics of loading containers to take place at a different speed and elevation than the main rail wheels in the air-ship.

FIGS. **5A-5B** show a design of a container lift vehicle. A container **400**, is loaded on the bed **401** of a vehicle **402** such as a truck or other vehicle where it is temporarily secured. The vehicle **402** then transports the container **400** to a specific hull loading position in proximity to the airship. The bed **401** then elevates the container **400** as shown in FIG. **5**B to a height for loading. The specific loading position and height location is predetermined so that the crane device **404** or other special device on the airship, or near the airship can grasp the container **400** and raise it to a correct loading position.

FIG. **6**A shows the subsequent loading process. The container **400** first has a rail wheel **406** attached to it. This can be done manually, or the crane device **404** can do it. The rail wheel **406** couples to the four corners of the container with cables **407**. The container **400** is then grasped by the special crane **404** that can typically roll into position with large wheels or can be fixed at a loading location. The crane **404** lifts the container to a desired vertical position with respect to the hull **405** and then manipulates the container to a desired lateral or horizontal position. The crane **404** generally has an extension rail **405** that mates with, and continues, a particular rail **403** from the ship hull **408**.

FIGS. **6**A and **6**B show the rail configuration inside the hull **408** of the airship. FIG. **6**A shows the side view configuration; FIG. **6**B shows a rear view configuration. Rails **403** run the length of the hull **408** and run parallel in rows across the hull. There are multiple levels of such rail rows depending upon the diameter of the hull. A 150 foot diameter can support approximately two vertical rail levels. A 300 foot diameter hull can support approximately four rail levels. The upper 80% of the hull **408** typically contains hydrogen lift equipment such as bladders and tanks previously described. The rails typically take up the remaining 20% of the hull. These percentages are approximate with different configurations possible with different lighter-than-air ships. The rails **403** can be single rails or rail pairs (or any other rail configuration). Single rails are preferred for efficiency and to keep weight down. The rails are separated vertically so that there is space for containers **400** to hang above one-another. A typical container is around ten feet high. The rail and wheel can occupy approximately five feet or slightly more, so that the vertical distance between rails is approximately fifteen feet.

FIG. **6**B shows an end-on view of the hull **408** and the rails **403**. Containers **400** are typically ten feet wide and can be packed closely on the sides. Thus, fifteen rows of rails horizontally takes up approximately 150 horizontal feet with the rails **403** spaced ten to twelve feet apart. Since the rails are typically located in the bottom 20% of the hull space, the rounded shape of the hull causes this number to be smaller. FIG. **6**B shows ten containers horizontally in the top row with some left over space on each side for possibly smaller containers, and four containers on the bottom row with some left over space. If, as shown in FIG. **6**A, the hull is long enough to line up sixteen containers fore and aft on each rail, the total number of containers in this example is 192 containers. This number is given for example only; numerous rail and container configurations are possible in different sized lighter-than-air ships.

The rails can be steel or they can be made from lighter strong aluminum or other metal alloys. The rail wheels can also be steel or made from lighter alloys. Using well known methods to those skilled in the art, various safety features may be added to reduce rocking and movement to acceptable tolerances, as well as to provide for safety straps in the event of a failure of the main harness or rail system.

FIG. **7** shows a rail tug **600** pushing a container **400** forward after it is engaged on a rail. Each container has a length of approximately forty feet and can be pushed as far forward as possible. Ten containers thus take up approximately 400 feet along the length of the hull. The sixteen containers of the previous example take up 640 feet. Again, the exact number of containers that a particular airship can hold depends entirely upon the dimensions of the airship hull and the total weight allowed depends on its lifting capacity. The rail tug **600** can be self powered, can move both fore and aft, and can optionally be remotely controlled, preferably wirelessly with safety features. It is typically designed to move fore and aft along different rails pushing or pulling containers into or from a shipping position. The rail tug can be equipped with emergency shutdown if it encounters a force greater than a predetermined amount. The crane device **404** can have a portion of rail where the rail tug **600** can pull back to leave room for a new container. As stated, the crane device **404** has a track continuation that can mate with any of the rails in the hull as the crane is moved vertically and horizontally. The rail tug **600** can use this rail extension as a parking place when not in use, or when waiting for a new container.

A similar system can be used to load and unload passengers. A passenger bus or other vehicle can load a particular number of passengers. The bus then conveys these passengers to the loading point at the bottom of the rear hull exactly like a cargo container. This is shown in FIG. **8**. The vehicle can elevate the passenger compartment **700** to a level where it can be hooked on four corners and loaded with a rail wheel onto a particular rail **704**, usually an empty rail. The passenger compartment **700** can then be pushed forward in the hull by a tug **600** exactly as a first cargo container would be. At the front end of the rail, the compartment encounters a soft stop **702** (which can be a plunger or the like), and interfaces with a hatch or doorway. The passengers can then leave the passenger compartment and enter the ship proper. This entry can be an ante-room with a stairway and/or elevator **702** that takes the passengers down to the gondola level **703**, or other passenger area where they will remain for the trip. Both cargo and passenger egress from the ship is handled in exactly the same way as disclosed above, run in reverse. Cargo is moved from the ship by the tug and loaded onto the special transport vehicle or loading line described in the optional embodiment. In the case of persons, passengers may ascend to the ante-room, entering the movable passenger compartment **700** through a hatch or doorway, and having the passenger compartment pulled (or pushed) out along the rail **704** to the point where the crane lowers the compartment to the bus base vehicle base or separate queue rail for transport to a terminal building.

FIGS. **9**A and **9**B show the separate queue rail **901** described above in the optional embodiment. FIG. **9**A illustrates the utility of this optional queuing rail in effecting a change in elevation from a traditional transport bed **403** of a truck or train car **402**, to the elevation of one of the main rails **704** in the lighter-than-air craft. FIG. **9**B, which is a top view, shows that such queuing rail slowly merges at junction **902** when in position with main rail **704**, thereby enabling the rail tug or other means to pull the container from queuing rail **901** and onto the main rail **704**. As noted previously, the process is reversed when unloading the ship in this optional embodiment.

The previous description of a cargo and passenger loading system can have many variations. It is not entirely necessary that all the rails be parallel; however, that is the most efficient configuration and the easiest to load. Other methods can be used to move the containers fore and aft besides a rail tug. For example, in an alternative embodiment, containers can be coupled to one another on the rail and pushed or pulled from the front end in a manner similar to a railroad train. It is also, it is not required that containers be transported by truck from a staging area to the hull loading location; they could be plucked off of railcars or brought in by separate trucks. It is also not necessary that trucks be able to elevate the containers. They can be picked up by the crane at ground level.

The terms and expressions employed herein have been used as terms of description and not of limitation; and thus, there is no intent of excluding equivalents, but on the contrary, such terms are intended to cover any and all equivalents that may be employed without departing from the spirit and scope of this disclosure.

I claim:

1. A loading system for a lighter-than-air craft hull comprising, in combination:
- a vehicle constructed to transport cargo containers into a hull loading area;
- a plurality of longitudinal rails located inside the lighter-than-air craft hull running fore and aft, each rail having a unique vertical position and a unique horizontal position inside the hull;
- a crane constructed to raise a particular container transported by said vehicle to the unique vertical position of one of the plurality of rails and to move the particular container horizontally to the unique horizontal position of said one of the plurality of rails;
- wherein the crane is also constructed to attach a rail wheel to the particular container and suspend the particular container from said one of the plurality of rails;
- a rail tug constructed to push or pull the particular container along said one of the plurality of rails forward into the hull to a final shipping location for the particular container.

2. The loading system of claim **1** wherein the vehicle is constructed to raise the particular container to a first height from where the particular container can be attached to the crane.

3. The loading system of claim **1** further comprising:
- a passenger compartment constructed to transport passengers carried on a bus vehicle from a terminal to the hull loading area, the passenger compartment constructed so that the crane can load the passenger compartment onto a particular rail using a rail wheel, the particular rail terminating in a passenger egress point where passengers can enter the lighter-than-air craft.

4. The loading system of claim **3** wherein the egress point terminates in an elevator or stairs constructed to allow passengers to descend from the hull to a gondola attached to the bottom of the lighter-then-air ship or to a passenger receiving area.

5. The loading system of claim **1** wherein the rail wheel is attached to the particular container by cables attached to four corners of the particular container.

6. The loading system of claim **1** wherein the crane includes wheels constructed so that it can roll into position at the hull loading area.

7. The loading system of claim **1** wherein the rail tug is configured to push containers along each of the plurality of rails until every rail is loaded.

8. The loading system of claim **1** wherein the rail tug is self-powered and can be remotely controlled.

9. The loading system of claim **8** wherein the rail tug is controlled wirelessly.

10. The loading system of claim **1** wherein all rails are parallel.

11. The loading system of claim **1** wherein each rail is a single rail.

12. The loading system of claim **1** wherein said plurality of rails occupies approximately 20% of said hull.

13. A loading system for a lighter-than-air ship comprising:
- a plurality of parallel rails located in a lighter-than-air ship hull, the rails running fore and aft in the hull;
- space for a plurality of cargo containers in the hull, wherein each cargo container can be equipped with a rail wheel and suspended from one of said rails from the rail wheel;
- a lifting device constructed to lift each container from a loading point and place it on a particular rail for shipping.

14. The loading system of claim **13** wherein the plurality of parallel rails occupies approximately 20% of the hull.

15. The loading system of claim **13** wherein the rails are configured in at least two horizontal rows located above one-another, each horizontal row containing two or more parallel rails.

16. A loading system for a lighter-than-air ship comprising:
- a plurality of parallel rails located in a lighter-than-air ship hull, the rails running fore and aft in the hull;
- space for a plurality of cargo containers in the hull, wherein each cargo container can be equipped with a rail wheel and suspended from one of said rails from the rail wheel;
- a loading line extended between the hull and a loading point below the lighter-than-air ship configured to enable a change in elevation between the loading point and an elevation of a particular rail in the hull for shipping.

17. The loading system of claim **16** wherein a queue of containers are placed on said loading line and pulled upward along the loading line onto the particular rail in the lighter-than-air ship.

* * * * *